POLLUTION

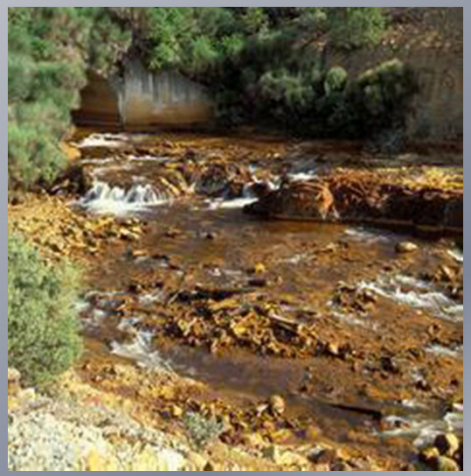
Water Pollution

Air Pollution

Pests and Pest Managment

Water Pollution

- Background
- Sources
- Types
- Eutrophication

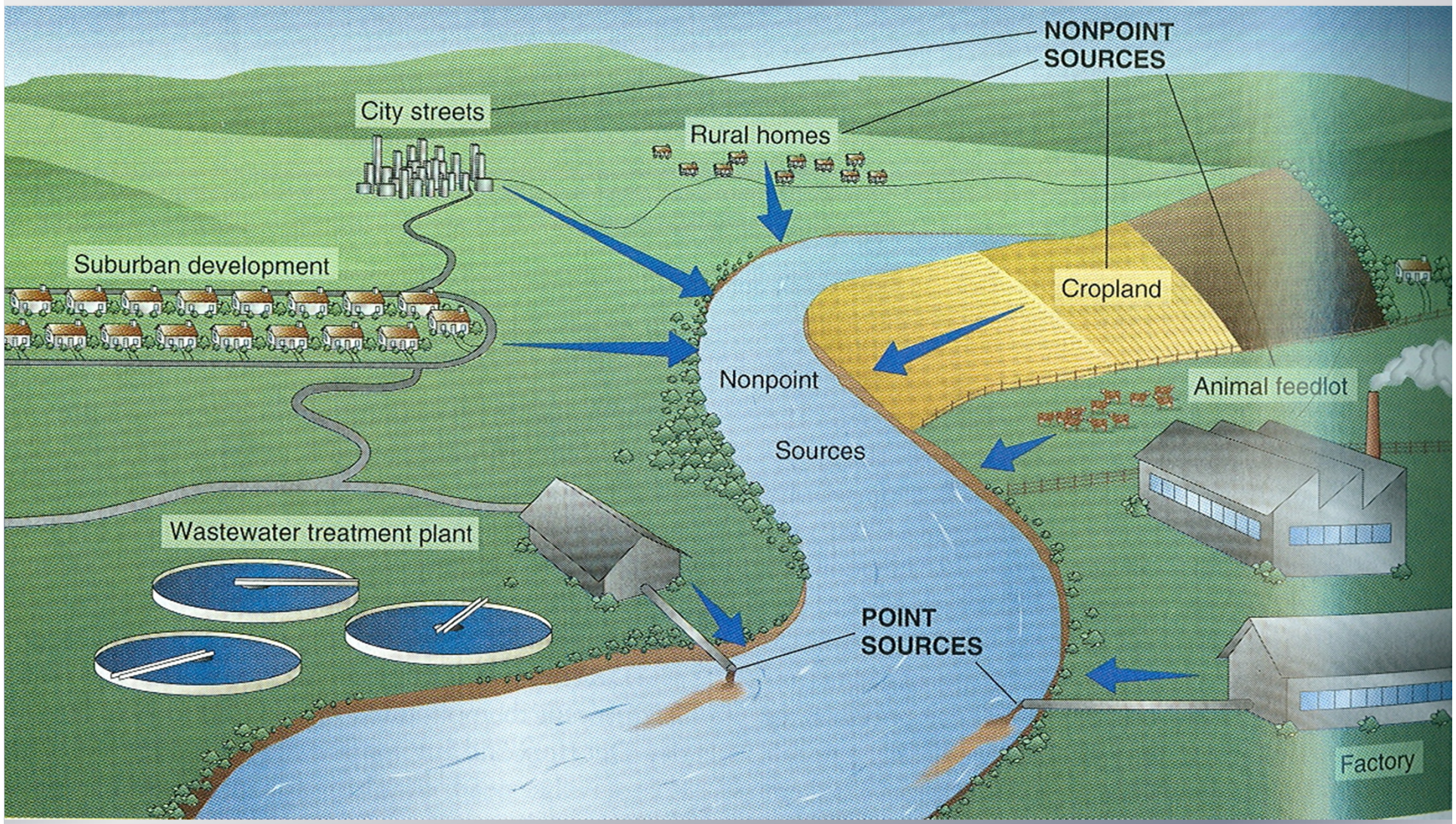


- ***Pollution*** =
  - The presence of a substance in the environment that prevents the functioning of natural processes and produces undesirable environmental and health effects
  - *Pollutant* = any material, natural or man-made, that causes pollution

- Strategies to manage pollution
  1. Identify materials causing the pollution
  2. Identify source of the pollutants
  3. Develop control strategies to prevent pollution
  4. Develop alternatives to avoid pollution altogether

Sources of Pollution

- ***Point sources*** =
  - Source of pollution with specific points of discharge
  - Examples
    - Factories
    - Sewage systems
    - Power plants
    - Coal mines
    - Oil wells
- ***Nonpoint sources*** =
  - Sources of pollution that are harder to identify
  - Examples
    - Agricultural runoff
    - Stormwater drainage
    - Acid rain


NONPOINT SOURCES
City streets
Rural homes
Suburban development
Cropland
Nonpoint
Sources
Animal feedlot
Wastewater treatment plant
POINT SOURCES
Factory

Types of Pollution

1. Chemical Pollutants
2. Pathogens
3. Organic Wastes
4. Sediments
5. Nutrients

1. Chemical Pollutants

- Inorganic chemicals
  - Heavy metals
  - Acids from mine drainage
  - Acid precipitation
  - Road salts
- Organic chemicals
  - Petroleum products
  - Pesticides
  - Detergents

- ***Biomagnification*** =
  - Pollutants become more concentrated by passing through several levels of the food web

2. Pathogens

- ***Pathogens*** =
  - Disease-causing bacteria, viruses, and other parasitic organisms
  - If wastes from carriers contaminate water, pathogens can infect others

- Methods for controlling waterborne diseases:
  1. Purify and disinfect water
  2. Sanitary collection and treatment of wastes
  3. Sanitary standards around food
  4. Public education in hygiene

3. Organic Wastes

- ***Detritus*** =
  - Dead organic matter, such as fallen leaves, twigs, and other plant/animal wastes

- As bacteria break down detritus, they use oxygen that is dissolved in water (DO)
- Lots of detritus = lots of oxygen getting used up
- This limits animal life

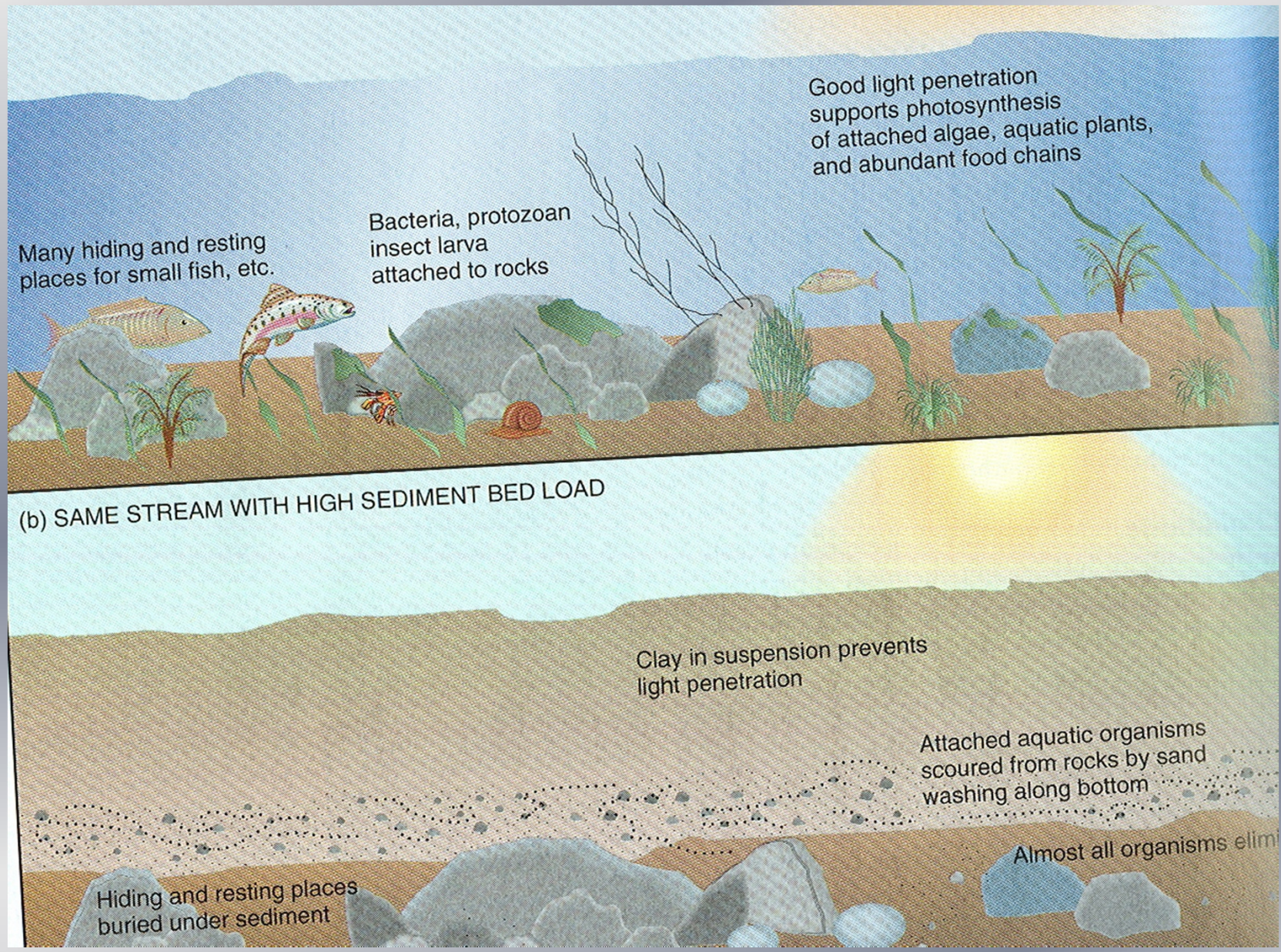
4. Sediments

- Erosion leads to more sediment in the water which disrupts the ecosystem

1. Muddy water reduces amount of light penetration and photosynthesis

2. Extra silt and sand removes attached aquatic organisms from rocks

3. Hiding and resting places get buried in sediment

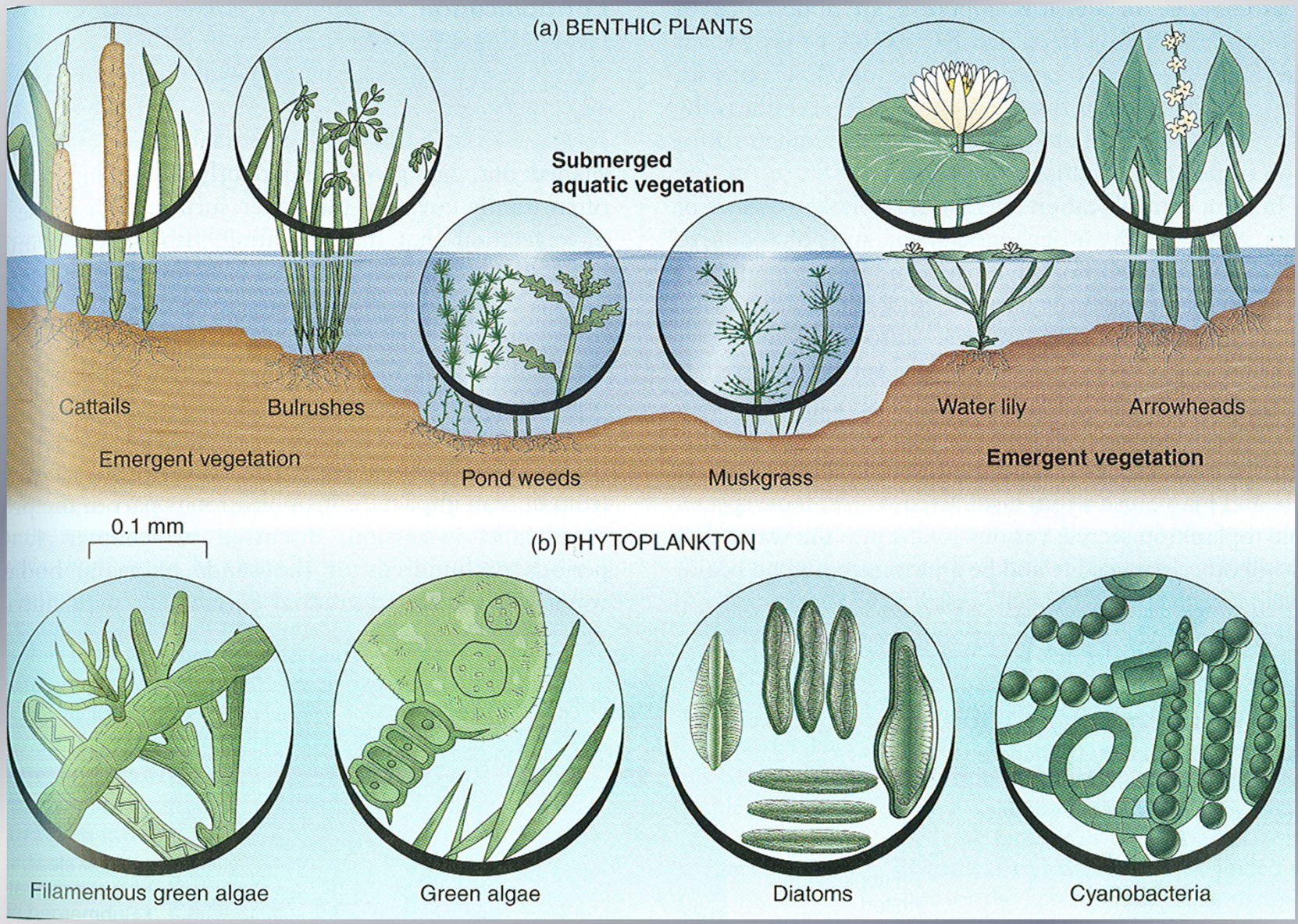

Good light penetration
supports photosynthesis
of attached algae, aquatic plants,
and abundant food chains
Many hiding and resting
places for small fish, etc.
Bacteria, protozoan
insect larva
attached to rocks
(b) SAME STREAM WITH HIGH SEDIMENT BED LOAD
Clay in suspension prevents
light penetration
Attached aquatic organisms
scoured from rocks by sand
washing along bottom
Almost all organisms elim
Hiding and resting places
buried under sediment

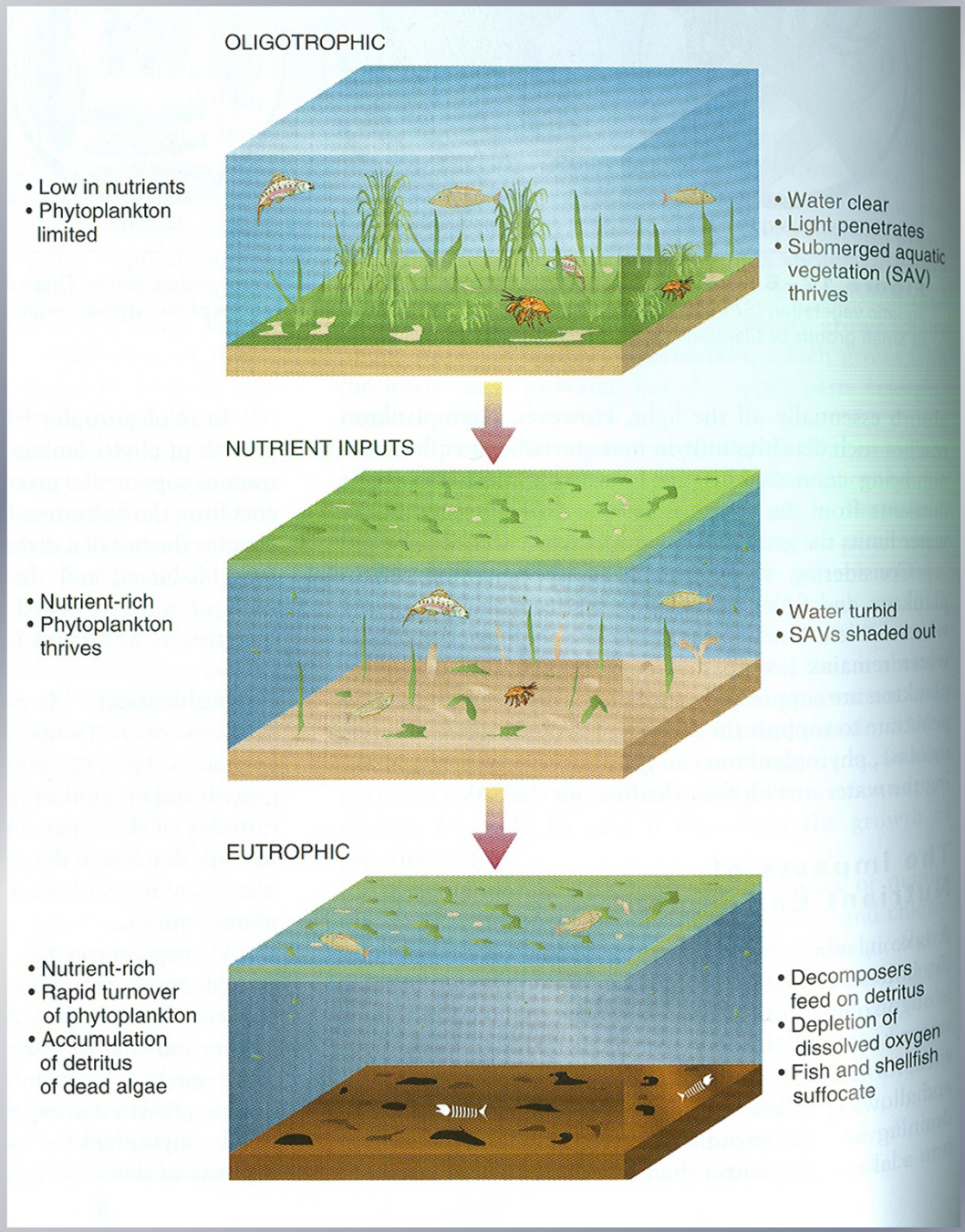
5. Nutrients

- Agricultural runoff is a primary source of nutrients
  - Phosphorus
  - Nitrogen
- Result:
  - Excessive plant growth

Eutrophication Background: Different Kinds of Aquatic Plants

- ***Phytoplankton*** =
  - Plants that live suspended in water
    - Not rooted down
    - Only found in water where light and nutrients are available
- ***Emergent vegetation*** =
  - Plants that are rooted in sediment, grow with lower parts in water, but upper parts stick out of water
    - Not limited by lack of nutrients in water or light penetration
- ***Submerged aquatic vegetation (SAV)=***
  - Plants that grow totally underwater
    - Need clear water that lets light through
    - Get nutrients from sediment, so they are not limited by water low in nutrients


(a) BENTHIC PLANTS
Submerged aquatic vegetation
Cattails
Bulrushes
Pond weeds
Muskgrass
Water lily
Arrowheads
Emergent vegetation
Emergent vegetation
0.1 mm
(b) PHYTOPLANKTON
Filamentous green algae
Green algae
Diatoms
Cyanobacteria


OLIGOTROPHIC
• Low in nutrients
• Phytoplankton limited
• Water clear
• Light penetrates
• Submerged aquatic vegetation (SAV) thrives
NUTRIENT INPUTS
• Nutrient-rich
• Phytoplankton thrives
• Water turbid
• SAVs shaded out
EUTROPHIC
• Nutrient-rich
• Rapid turnover of phytoplankton
• Accumulation of detritus of dead algae
• Decomposers feed on detritus
• Depletion of dissolved oxygen
• Fish and shellfish suffocate

Sequence of Eutrophication:

1. Nutrients are added to water
2. Phytoplankton grow
3. Phytoplankton block light
4. SAV die
5. Phytoplankton die (competition)
6. Detritus builds up
7. Bacteria grow (break down detritus)
8. Dissolved oxygen gets used up by bacteria
9. Animals suffocate and die

Combating Eutrophication

- Attack symptoms (phytoplankton, lack of oxygen)
  - Herbicides
  - Aeration
  - Harvesting aquatic weeds
  - Drawing water down

- Eliminate source (cut down on nitrogen and phosphorus in water)
  - Ban sale of phosphate detergents
  - Issue and monitor permits for discharging pollutants
  - ***Best management practices*** =
    - Farm management practices that serve best to reduce soil and nutrient runoff

Air Pollution

- Background
- Types of Pollutants
- Smog
- Acid Precipitation
- Impact of Air Pollutants
- Greenhouse Effect
- The Ozone Layer
- Control Strategies

Background

- ***Air pollutants*** =
  - Substances in the atmosphere that have harmful effects
- Air pollutants can be natural
  - From volcanoes, fires, dust storms, and other natural processes

  - There are natural cleansing agents that remove and recycle natural pollutants
  - BUT, nature can't remove all of the pollution humans are creating fast enough

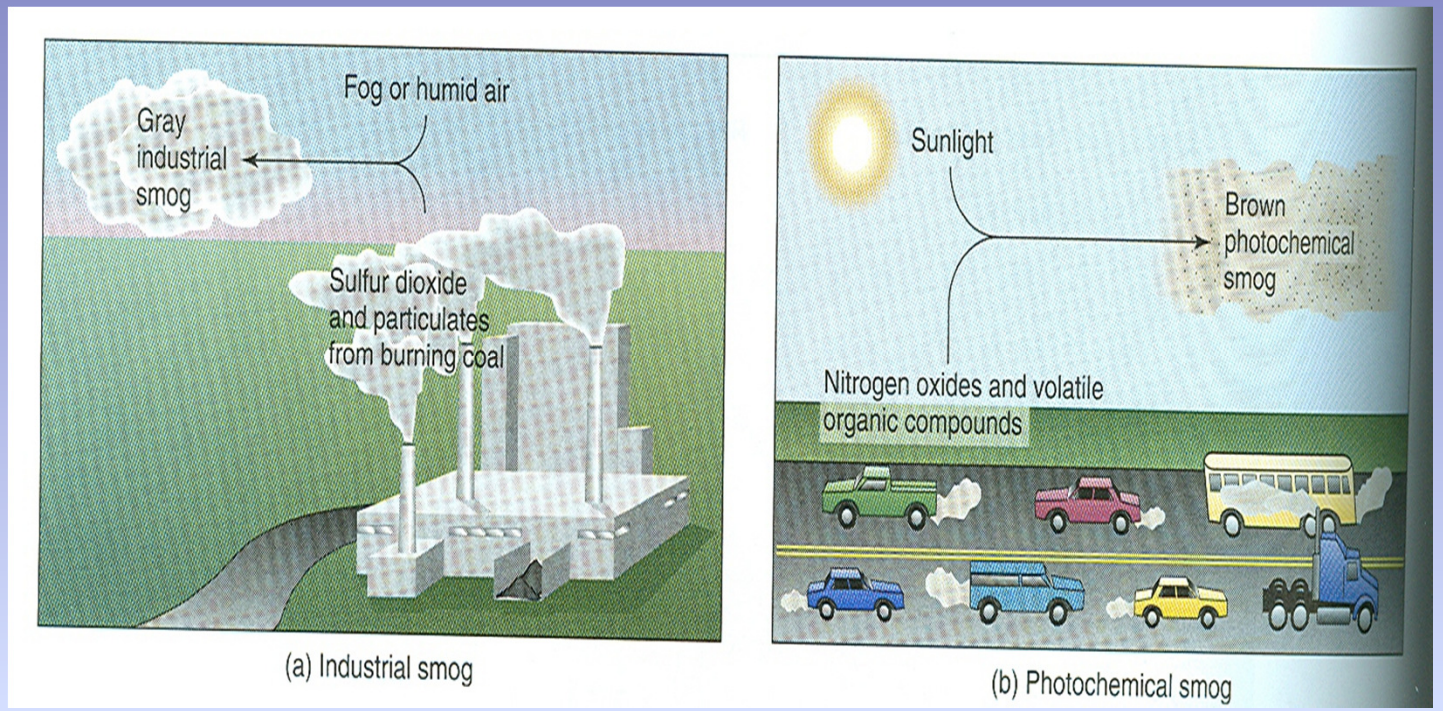
Types of Pollutants

- ***Primary pollutants*** =
  - Pollutants released *directly* into atmosphere mainly as a result of burning fuels and wastes
  - Examples
    - Carbon monoxide (CO)
    - Nitrogen oxides (NOx)
    - Sulfur oxides (SOx)
    - Lead (Pb)
    - Radon (Rn)
- ***Secondary pollutants*** =
  - Pollutants resulting from *reactions* of primary air pollutants in the atmosphere
  - Examples
    - Ozone (O_3)
    - Sulfuric acids
    - Nitric acids

Smog

- ***Industrial smog*** =
  - Grayish mixture of moisture, soot, and sulfurous compounds
  - Occurs in industrial areas and where coal is a primary energy source

- ***Photochemical smog*** =
  - Brownish haze that typically forms over large cities with lots of automobile traffic



Impacts of smog

- Pollutants can build up to dangerous levels
- Can cause headaches, nausea, eye and throat irritation
- Affects trees and other vegetation also

Acid Precipitation

- ***Acid*** =
  - Has a pH less than 7
- ***Base*** =
  - Has a pH greater than 7
- pH scale

  0 (highly acidic) → 7 (neutral) → 14 (highly basic)
- In the absence of pollution, rainfall is normally slightly acidic, with pH of 5.6
- ***Acid precipitation*** =
  - Acid rain, acid fog, acid snow, and other forms of precipitation that is more acidic than normal
    - pH less than 5.6

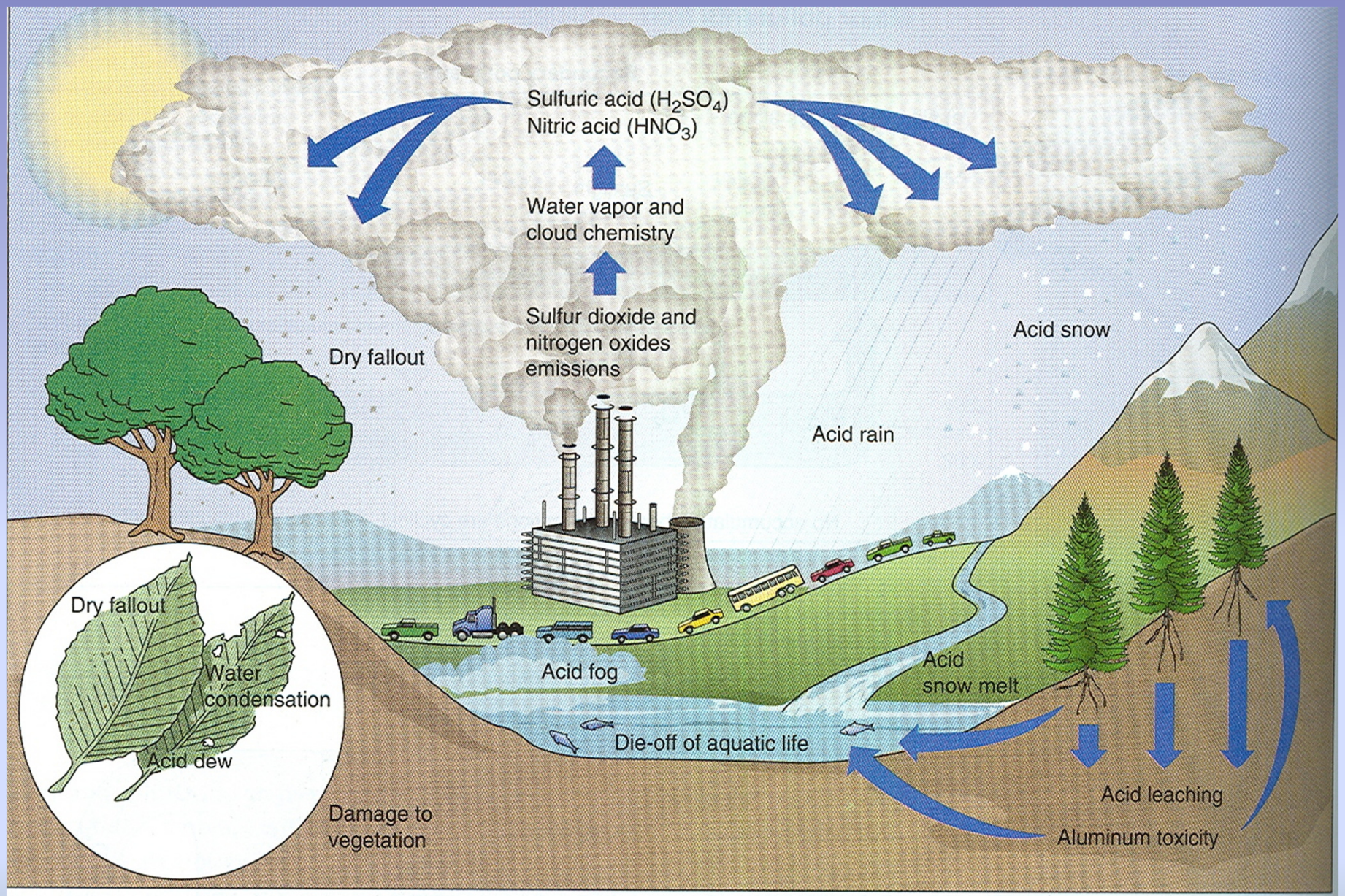
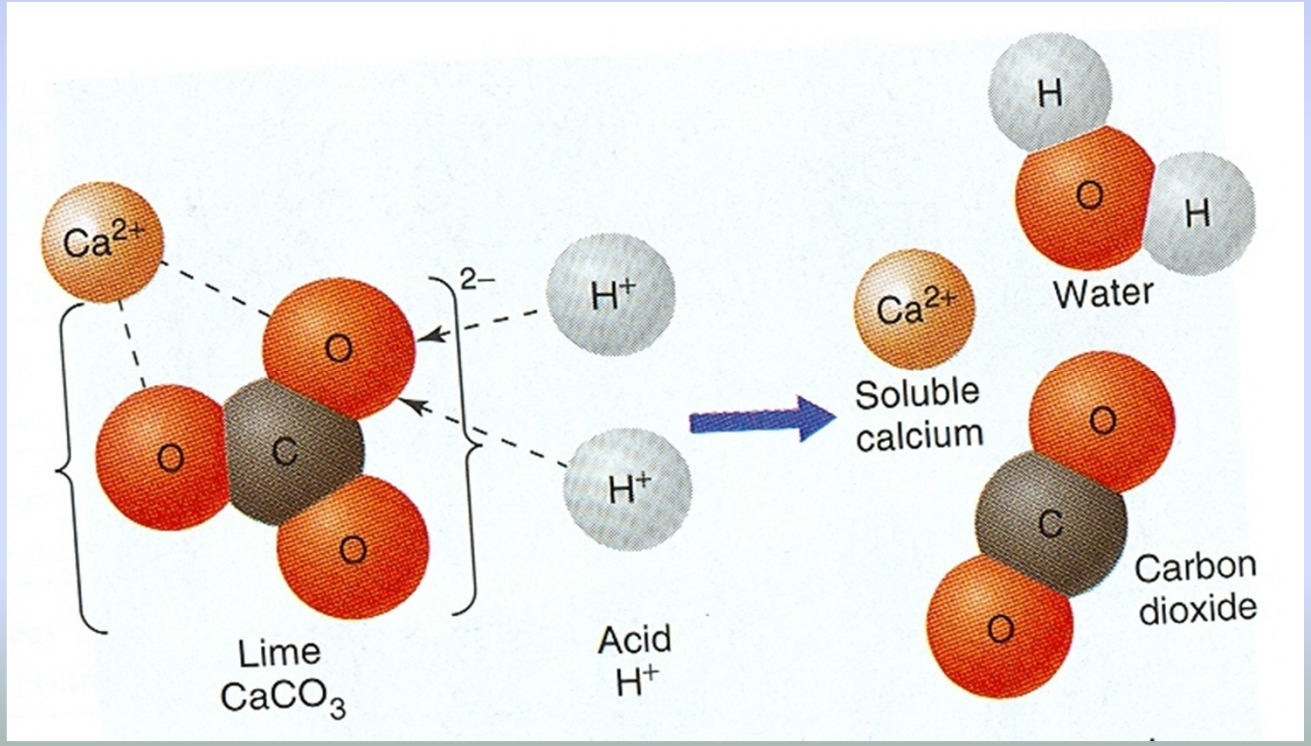


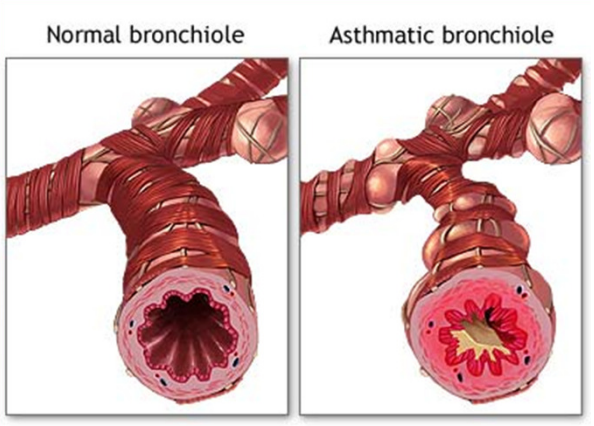
Figure 21–12 Acid deposition. Emissions of sulfur dioxide and nitrogen oxides react with hydroxyl radicals and water vapor in the atmosphere to form their respective acids, which return to the surface either as dry acid deposition or, mixed with water, as acid precipitation. Various effects of acid deposition are noted.

- Buffer, the Acid Slayer
  - ***Buffer*** =
    - Substance that will neutralize the pH of a solution
    - Limestone is a natural buffer



Impact of Air Pollutants

- Effects on Human Health
  - Those most sensitive to air pollution are
    - Small children
    - Asthmatics
    - People with chronic lung or heart disease
    - The elderly

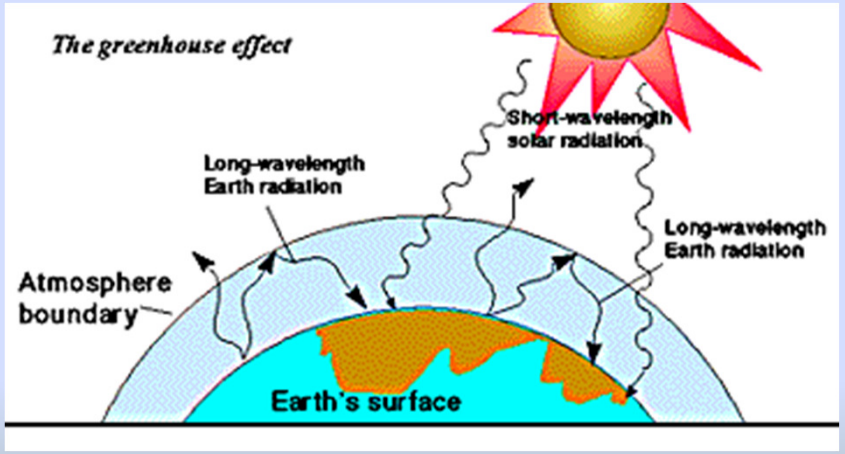


- Effects on Materials and Buildings
  - Walls and windows turn gray
  - Paints and fabrics deteriorate more rapidly
  - Rubber products become hard and crack
  - Metal corrosion increases
  - Limestone and marble buildings and monuments erode quickly
  - Visibility decreases

- Effects on the Environment
  - Plants are even more sensitive to gaseous air pollutants than are humans
    - Crop damage
    - Forest damage
  - Aquatic ecosystems become more acidic
    - Kills organisms
    - Upsets balance

The Greenhouse Effect

- ***Greenhouse gases (GHGs)*** =
  - Gases in atmosphere that absorb infrared energy and contribute to air temperature
    - Examples: CO_2, water vapor, methane, nitrous oxide, ozone, chlorofluorocarbons and other halocarbons
  - Create a "heat blanket" important in insulating Earth's surface



- Benefit of greenhouse gases:
  + Keep the surface of Earth warm and livable!
- Drawback of greenhouse gases:
  - Too many trap too much heat, increasing the temperature on Earth too much!

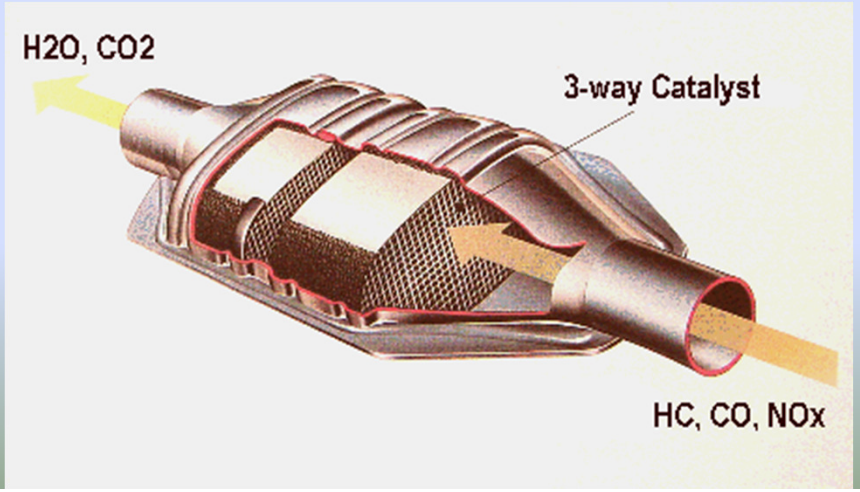
The Ozone Layer

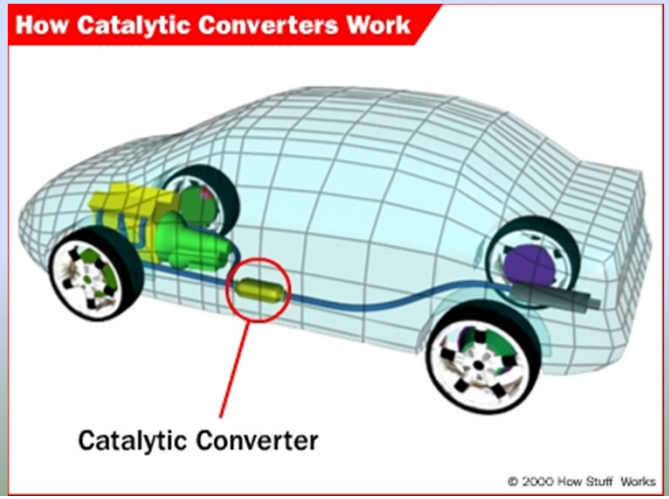
- Ozone in the troposphere (lowest level of atmosphere) acts as a greenhouse gas
  - Too much is considered pollution by trapping extra heat!
- The ozone layer in the stratosphere (higher level of atmosphere) protects us from harmful UV rays
  - UV radiation damages protein and DNA, causing sunburn and skin cancer
- Think:
  - Bad near by!
  - Good up high!

- The “Hole” in the Ozone Layer
  - Ozone is broken down by pollutants such as CFCs
    - ***Chlorofluorocarbons (CFCs)*** =
      - Act as transport agents that continuously move chlorine atoms, which destroy ozone, into stratosphere
  - Destruction of ozone layer is occurring worldwide
    - Layer is getting thinner
    - More UV radiation is getting through

Control Strategies

- 1978 EPA banned use of CFCs in aerosol cans in US
- Limiting pollutants from motor vehicles
  - ***Catalytic converter*** =
    - Reduces amount of CO and hydrocarbons in a car's exhaust





- Legislation
  - Clean Air Act of 1970 (CAA)
    - Calls for identifying and controlling most wide-spread pollutants
    - Setting ambient standards
      - Determine certain levels of pollutants that should not be exceeded in order to maintain environmental and human health
  - Title IV of Clean Air Act Amendments
    - 1st law in US history to address acid-precipitation problem

PESTS
and
PEST CONTROL

I. The Need for Pest Control

- ***Pest*** =
  - Any organism that is destructive or troublesome
  - ***Agricultural pests*** =
    - Organisms that feed on plants, agricultural crops, or animals
  - ***Weeds*** =
    - Plants that compete with agricultural crops, forests, and other important plants for light and nutrients

VARIOUS PESTS

- Insects
  - Aphids
  - Caterpillars
  - Hornets
- Rodents
  - Chipmunks
  - Moles
  - Rabbits
- Birds
  - Woodpeckers
  - Pigeons
- Bats

INTRODUCED SPECIES

- Not native to the area
  - Introduced by humans
- Problems
  - May not encounter natural enemies
    - Population may explode
  - May eat organisms we don't want them to
    - Destroy crops and other plants
  - May disrupt balance in an ecosystem
- Examples
  - Rabbits in Australia
  - Japanese beetle
  - Gypsy moth

- 3 purposes for bringing pests under control

1. Protect our food
2. Protect our health
3. Convenience

- ***Herbicides*** =
  – Chemicals that kill plants

- ***Pesticides*** =
  – Chemicals that kill animals and insects considered to be pests

Integrated Pest Management

- Long-term management approach to control pest populations
- Uses all suitable methods
  - Chemical
  - Ecological
- Minimal environmental impact

II. Problems with the Chemical Approach

1. Human health effects
2. Environmental effects
   - DDT caused birds to lay fragile eggs
3. Development of Resistance by pests

4. Resurgences and secondary-pest outbreaks

- ***Resurgence*** =
  - Rapid comeback of a population and return to even higher levels than before the treatments

- ***Secondary-pest outbreak*** =
  - Small population of pests suddenly explodes to become a serious problem

III. Alternative Pest Control Methods

- ***Natural Pest Control*** =
  - Controlling a pest population without synthetic chemicals
  - 4 general categories
    - A. Cultural Control
    - B. Control by Natural Enemies
    - C. Genetic Control
    - D. Natural Chemical Control

A. Cultural Control

- Non-chemical alteration of environmental factors
- Pest finds the environment unsuitable or is unable to gain access to its target

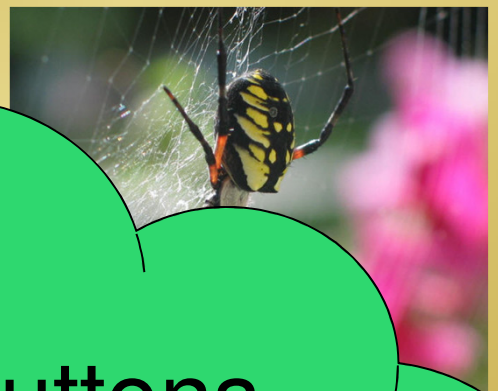
- Examples
  - Disposing properly of sewage
  - Putting screens on windows
  - Putting fences around yards/gardens
  - US Customs Bureau

B. Control by Natural Enemies

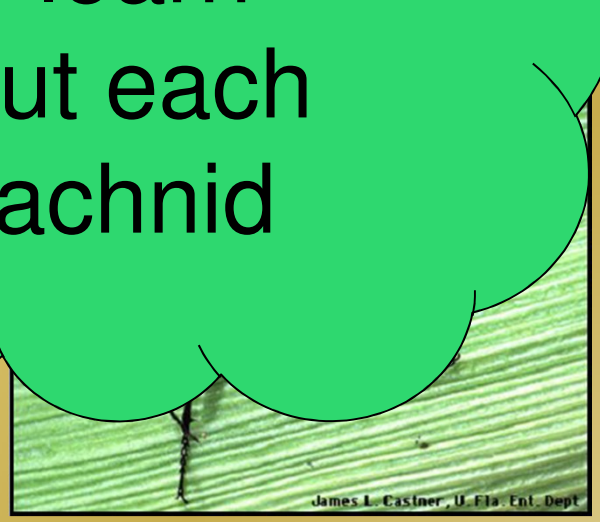
- Various caterpillars controlled by parasitic wasps
- Rabbits controlled by virus
- Water hyacinth controlled by Brazilian weevils

- Problems:
  - Want organism to control target species and not attack other species
  - Natural enemies could overpopulate

Most Wanted!



Click the buttons below to learn more about each insect/arachnid



LADY BEETLES

- Alias:
  - Lady bugs, Ladybird beetles
- Identifying marks:
  - Adults
    - Red, orange, or tan with tattooed black spots on wing covers
  - Larvae
    - Disguised as tiny alligator
    - Generally black with orange markings
- Wanted for:
  - Attacking aphids, mites, insect eggs, and small insects
- Reward:
  - Aphid-free roses and vegetable

SPIDERS

- Identifying marks:
  - 8 legs
  - 2 body parts
  - Known in many colors and disguises
- Wanted for:
  - Kidnapping insects
  - May be active hunters or use web traps
  - Can be found almost anywhere
- Last seen:
  - Headed for your garden

SYRPHID FLIES

- Alias:
  - Hover flies, Flower Flies
- Identifying marks:
  - Harmless adults
    - Often found disguised as bees
    - Found pollinating flowers
  - Larval maggots
    - Small, legless, slug-like
- Larvae wanted for:
  - Attacking aphids

GROUND BEETLES

- Alias:
  - Carabids
- Identifying marks:
  - Large, dark, sometimes metallic beetles
  - May be moving fast along ground
- Wanted for:
  - Preying on many low-dwelling soft-bodied insects

C. Genetic Control

- Control with chemical barriers
  - Plant produces a chemical that kills pest or tastes/smells bad
- Control with physical barriers
  - Selective breeding for physical features that prevent pest from reaching part of plant
    - Hooked leaf surfaces
    - Sticky substances

- Control with sterile males
  - Can’t reproduce
  - Numbers drop
- Strategies using biotechnology
  - Genetically engineering plants with resistance

D. Natural Chemical Control

- ***Hormones*** =
  - Natural chemical substances that control development and behavior of organisms
- ***Pheromones*** =
  - Natural chemical substances produced by certain members of a species that affect the behavior of other members of the same species

- Use hormones and pheromones to disrupt insect's life cycle
- Benefits
  - Nontoxic
  - Species-specific